



## RS900 Series Family of Switches



## Installation Guide

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# 1 Product Overview

## 1.1 *Functional Overview*

The RS900 family of switches are environmentally hardened, fully managed switches supporting a variety of Ethernet interfaces including copper, fiber, wireless as well as Serial communications. The RS900 family's superior ruggedized design coupled with the RuggedSwitch Operating System (ROS) provides improved system reliability and advanced networking features making it ideally suited for creating Ethernet networks for mission-critical, real-time, control applications.

### RS900 Family Common Product Features

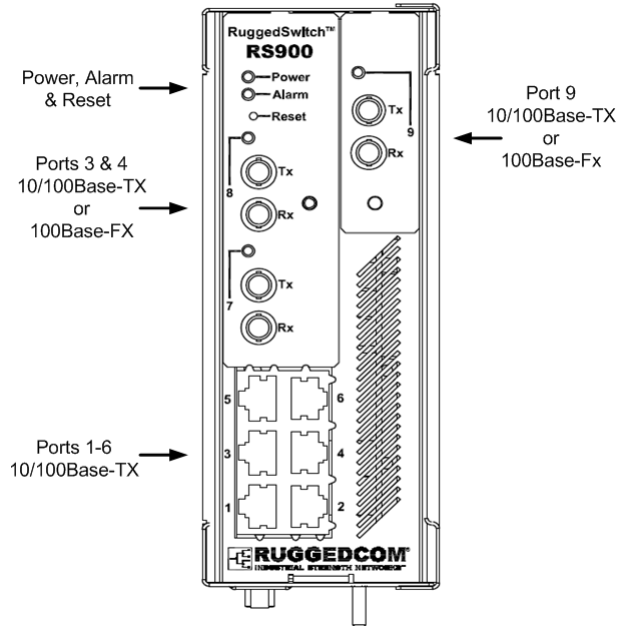
- Operating temperature: -40° to 85°C (no fans)
- Fully integrated power supply
- Power supply options: 12, 24, 48 or 60 VDC, and Universal HI (88-300VDC or 84-264VAC)
- Failsafe output relay for critical failure or error alarming
- Industry standard fiber optical connectors: LC, SC, ST, MTRJ
- Multimode and Singlemode optical transceivers
- Long haul optics allow distances up to 90 km
- Advanced layer-2 switching functions including Flow-Control, Link Aggregation, MAC Bridges, Rapid Spanning Tree, Message Prioritization, VLANs and Port Based Network Access Control

## 1.2 RuggedSwitch

### RS900

#### 9 Port Fiber Optic Ethernet Switch

- Up to 9 fast Ethernet ports
- Copper and fiber options



## 1.3 RuggedWireless Family of Products

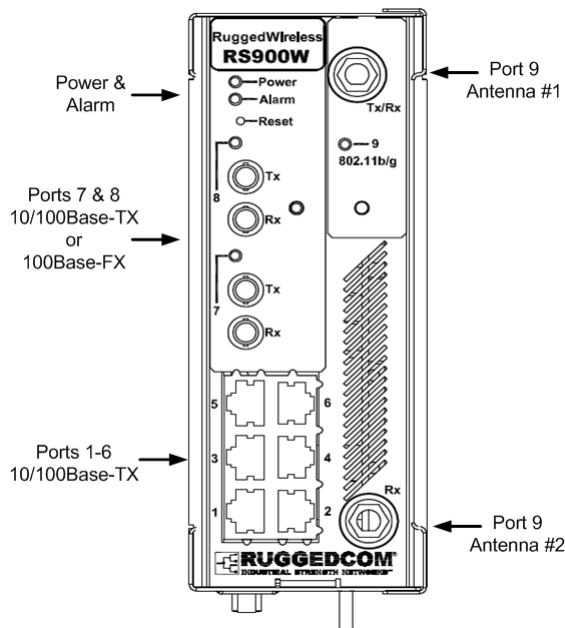
### Wireless Port Characteristics

- Configurable as an access, client, or bridge device
- IEEE 802.11b/g Wireless Access Point with data rates up to 54 Mbps
- WPA (Wi-Fi Protected Access) with TKIP for enhanced security and encryption
- WPA2 / 802.11i with CCMP for robust security and encryption
- IEEE 802.1X / RADIUS using EAP-PEAP for secure "enterprise class" authentication configuration
- Pre-shared Key Mode (PSK) for "personal" mode authentication configuration

#### RS900W

Wireless Ethernet with integrated 8-Port Switch

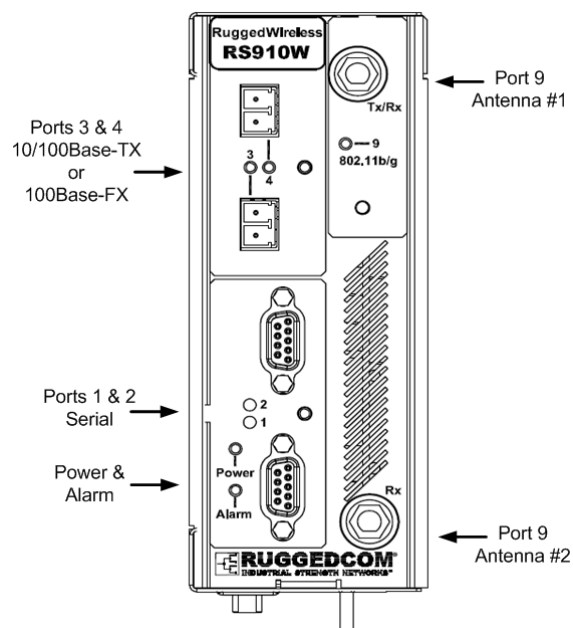
- 1 Wireless interface
- Up to 8 fast Ethernet ports
- Copper and fiber options



#### RS910W

Wireless Serial Device Server with 2 Serial and/or 2 Ethernet Ports

- 1 Wireless interface
- 2 RS485/RS422/RS232 Serial ports (DB9 or RJ45); Serial Fiber interface (ST) available
- 2 Optional Ethernet ports

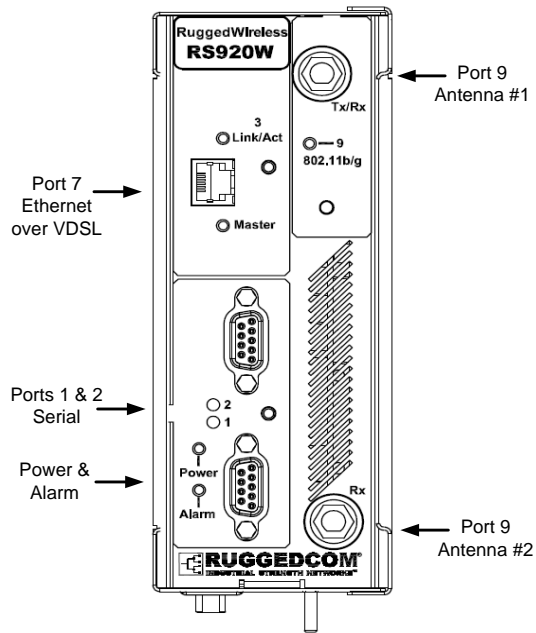




## RS920W

Wireless Serial Device Server with 2 Serial Ports and 1 Ethernet over VDSL Interface

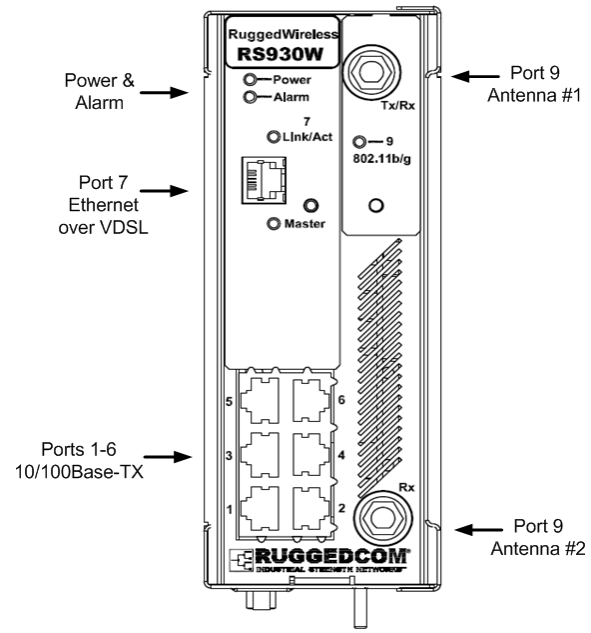
- 1 Wireless interface
- 1 EoVDSL interface
- 2 RS485/RS422/RS232 Serial ports (DB9 or RJ45); Serial Fiber interface (ST) available



## RS930W

Wireless Ethernet with Integrated 6-Port Switch and 1 Ethernet over VDSL Interface

- 1 Wireless interface
- 1 EoVDSL interface
- 6 fast Ethernet ports



## 1.4 RuggedVDSL Family of Products

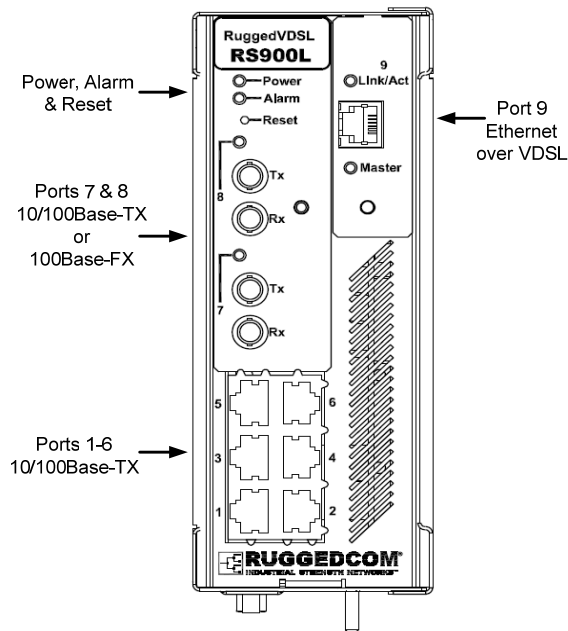
### EoVDSL Port Characteristics

- Symmetric data rates up to 35 Mbps with distances up to 2.5 km
- Asymmetric data rates up to 40 Mbps with distances up to 5 km
- Automatically selects fastest data rate based on distance and quality of cable
- Manual speed configuration available

#### RS900L

Ethernet over VDSL with integrated 8-Port Switch

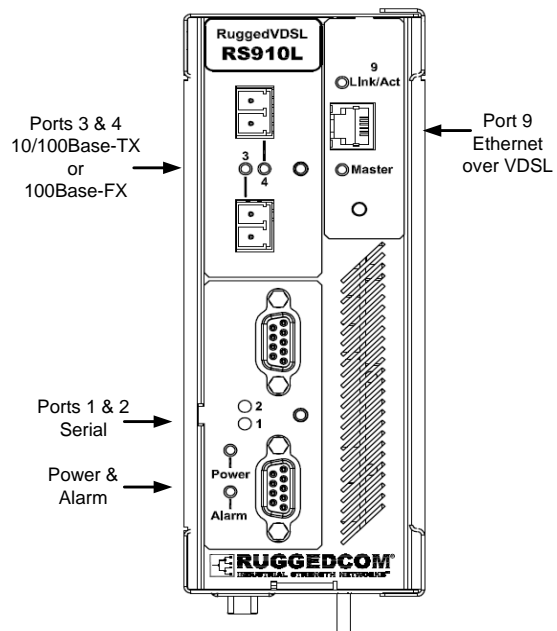
- 1 EoVDSL interface
- Up to 8 fast Ethernet ports
- Copper and fiber options



#### RS910L

Ethernet over VDSL with 2 Serial and/or 2 Ethernet Ports

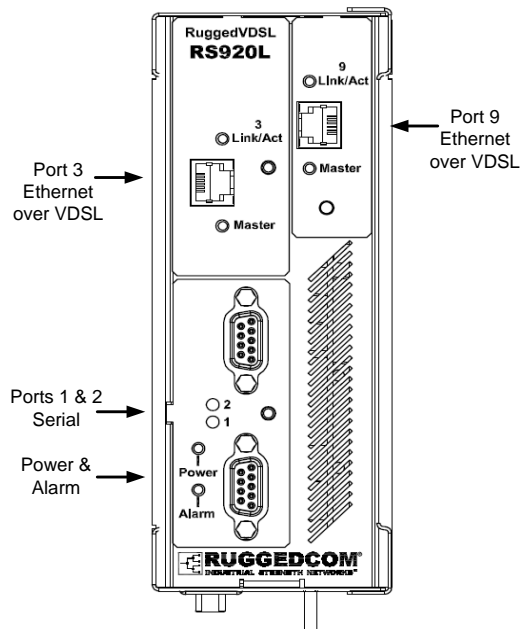
- 1 EoVDSL interface
- 2 RS485/RS422/RS232 Serial ports (DB9 or RJ45); Serial Fiber interface (ST) available
- 2 Optional Ethernet ports



## RS920L

Dual Ethernet over VDSL interfaces with integrated Dual Port Serial Server

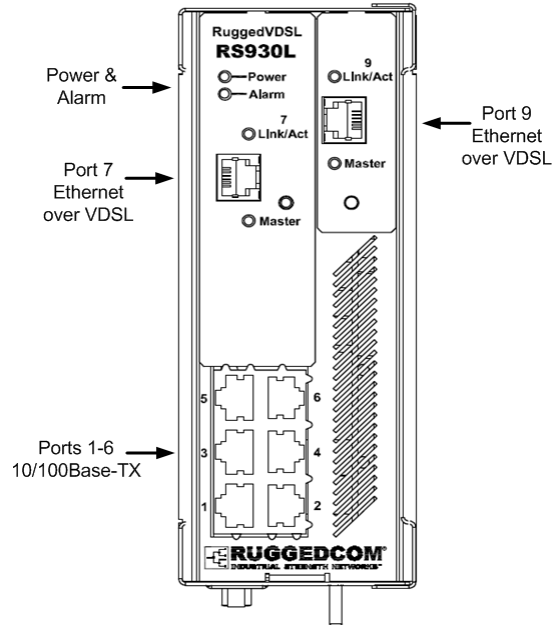
- 2 EoVDSL interfaces
- 2 RS485/RS422/RS232 Serial ports (DB9 or RJ45); Serial Fiber interface (ST) available



## RS930L

Dual Ethernet over VDSL interfaces with Integrated 6-Port Switch

- 2 EoVDSL interfaces
- 6 fast Ethernet ports

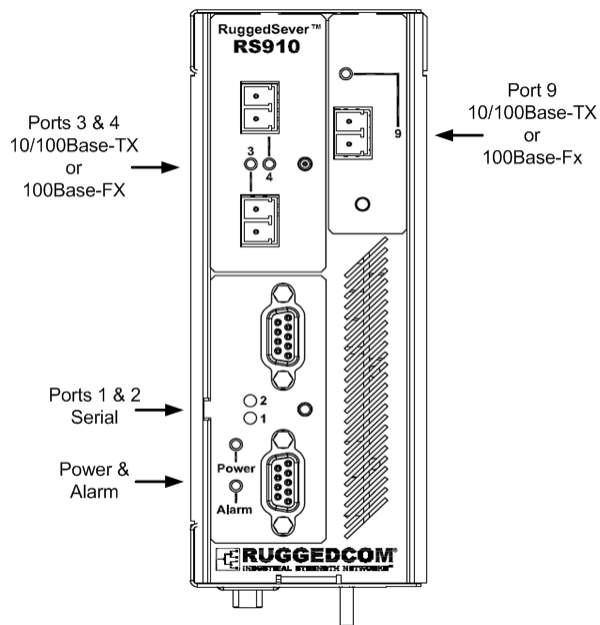


## 1.5 RuggedServer

### RS910

2-Port Serial Device Server with up to 3 Ethernet Ports

- 2 RS485/RS422/RS232 Serial ports (DB9 or RJ45); Serial Fiber interface (ST) available
- Up to 3 fast Ethernet ports
- Copper and fiber options



## 1.6 Front Panel Description

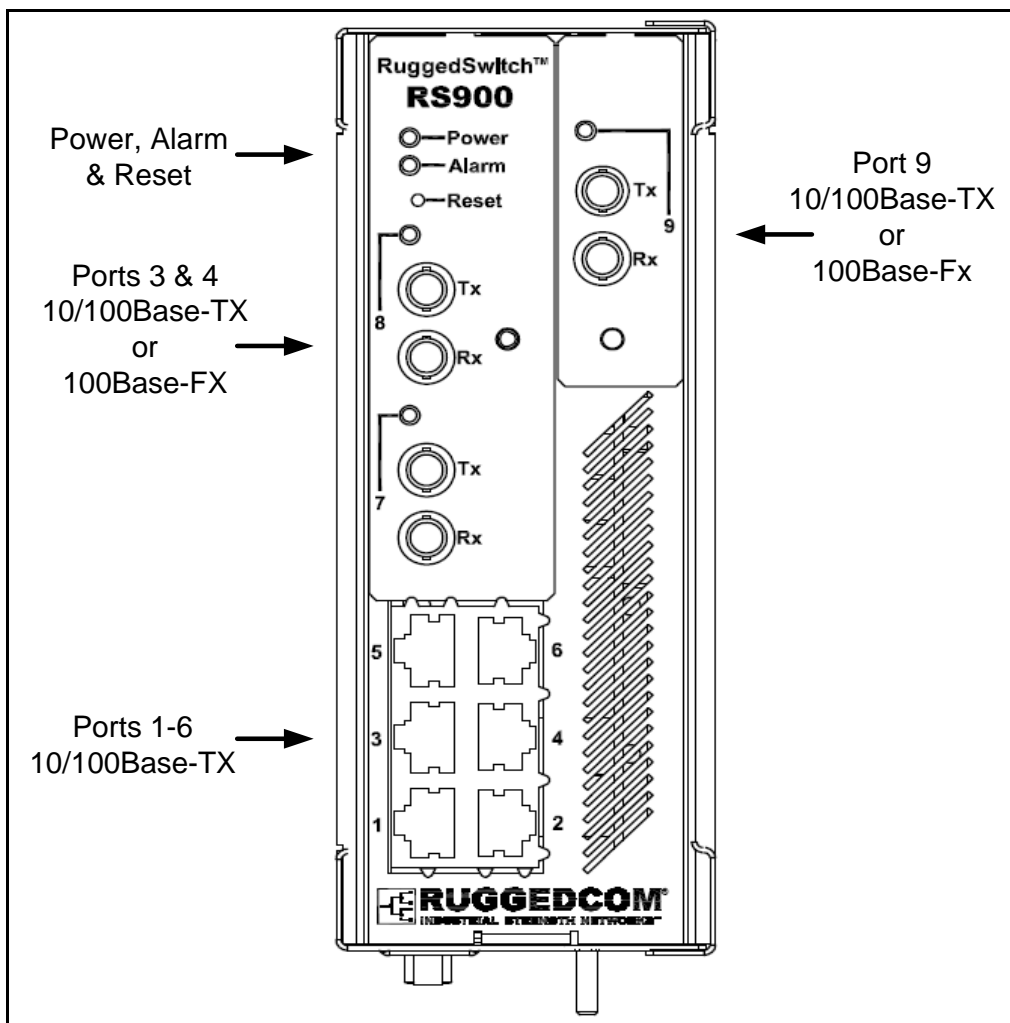


Figure 1 - Front Panel Description

<i>Status LED</i>	<i>Colour</i>	<i>Activity</i>	<i>Comments</i>
Power LED	Green	Solid	Power On
Alarm LED	Red	Solid	Alarm condition exists

Table 1 - Status LEDs

## 1.7 Bottom Panel Description

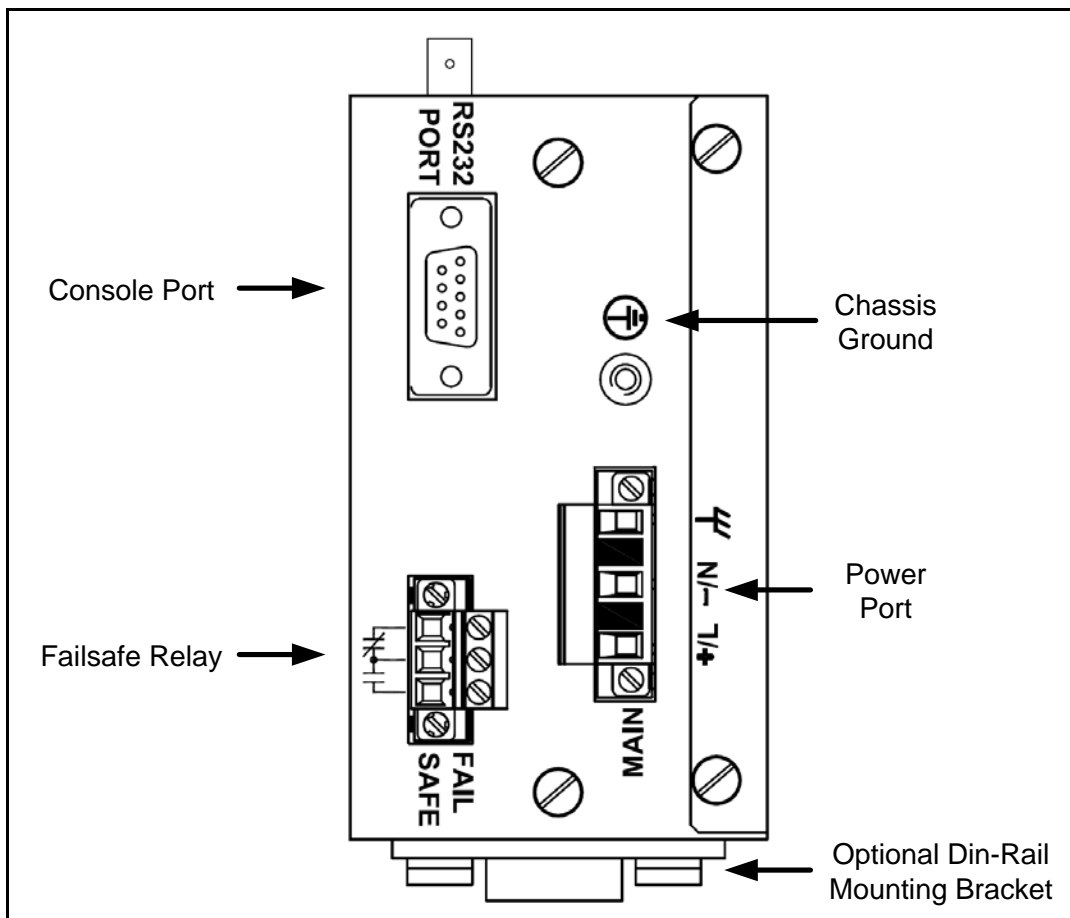


Figure 2 - Bottom Panel Description

## 2 Installation

### 2.1 Din Rail Mounting

An optional DIN rail-mounting bracket is available for the unit. The figure below details mounting instructions for the standard 1" DIN Rail.

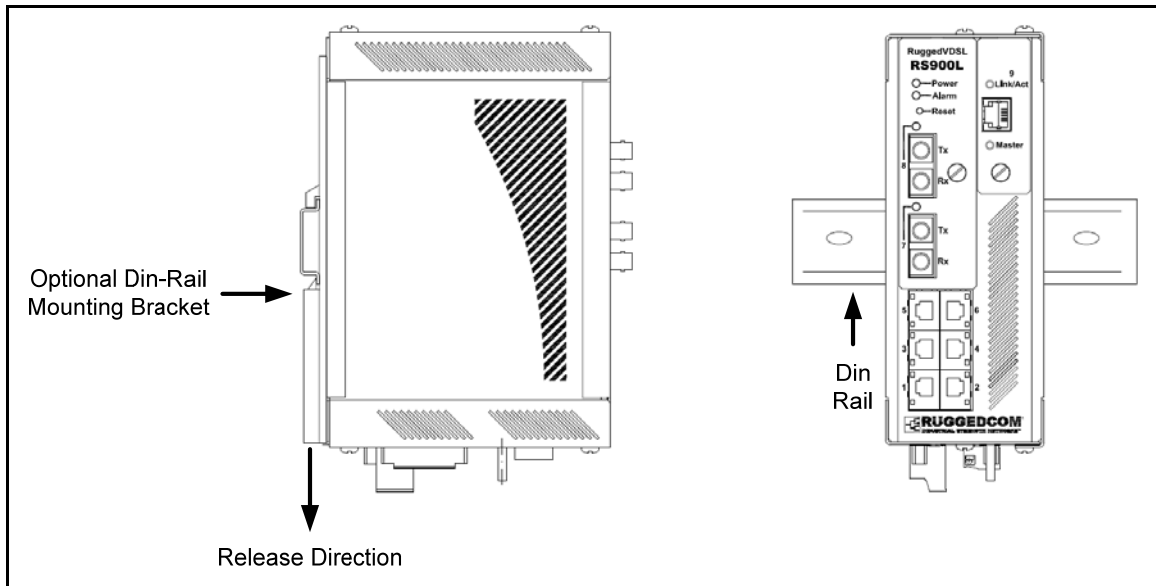


Figure 3 - DIN Rail Mounting

## 2.2 Power Supply Wiring and Grounding

### 2.2.1 AC Power Supply Wiring and Grounding

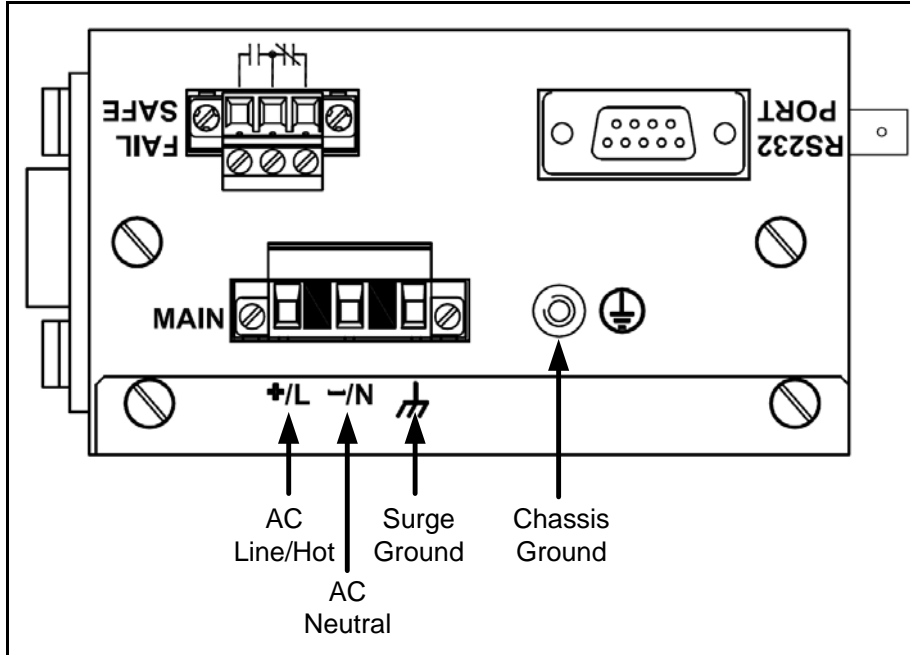


Figure 4 - Power Supply Inputs

The AC power supply inputs should be connected as follows:

1. +/L should be connected to AC Line/Hot.
2. -/N should be connected to AC Neutral.
3. Surge Ground should be connected to the Chassis Ground via a braided cable or other appropriate grounding wire. Surge Ground is used as the ground conductor for all surge and transient suppression circuitry internal to the unit.
4. Chassis Ground must be connected to the AC ground terminal.

#### NOTES:

1. Equipment must be installed according to the applicable country wiring codes.
2. All line-to-ground transient energy is shunted to the Surge Ground terminal. In cases where users require the inputs to be isolated from ground, remove the ground braid between Surge and Chassis Ground. Note that all line-to-ground transient protection circuitry will be disabled.



## 2.2.2 DC Power Supply Wiring and Grounding

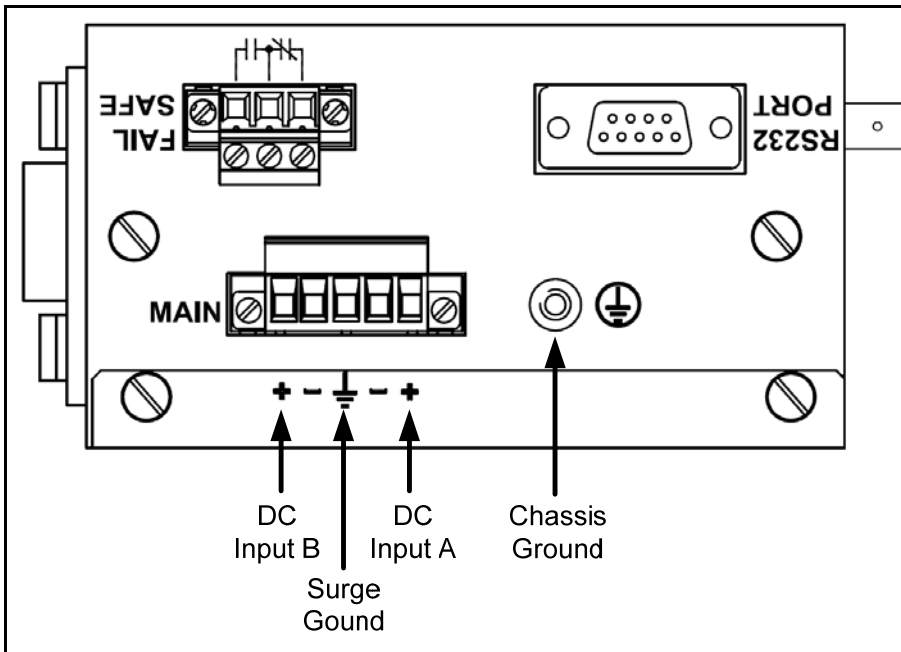


Figure 5 - DC Power supply wiring and grounding diagram

The low voltage DC power supply features reverse polarity protection and dual independent inputs. The latter feature allows the connection of two DC sources with the same nominal voltage to provide redundant power supply inputs.

The DC power supply inputs should be connected as follows:

1. Connect to the DC inputs according to the polarity markings on the unit.
2. Surge Ground should be connected to the Chassis Ground via a braided cable or other appropriate grounding wire. Surge Ground is used as the ground conductor for all surge and transient suppression circuitry internal to the unit.
3. Chassis Ground must be connected to the protective earth.

### NOTES:

1. Equipment must be installed according to the applicable country wiring codes.
2. All line-to-ground transient energy is shunted to the Surge Ground terminal. In cases where users require the inputs to be isolated from ground, remove the ground braid between Surge and Chassis Ground. Note that all line-to-ground transient protection circuitry will be disabled.

### 2.2.3 Failsafe Output Wiring

The Failsafe output relay is provided to signal critical error conditions that may occur on the unit. The contacts are energized upon power up of the unit and remain energized until an alarm condition or power loss occurs.

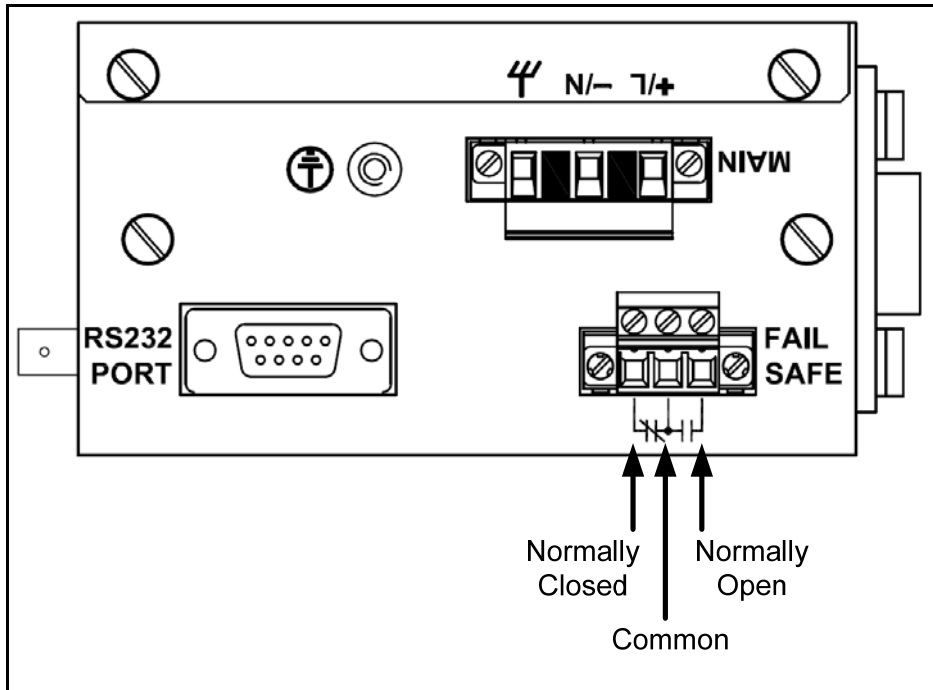


Figure 6 - Failsafe Output Relay

## 2.2.4 Dielectric Strength Testing

Units which are to have dielectric strength testing (HIPOT testing) done in the field must have the braided ground cable disconnected during the test. This is required in order to prevent the surge suppression circuitry, which is connected to surge ground, from being activated.

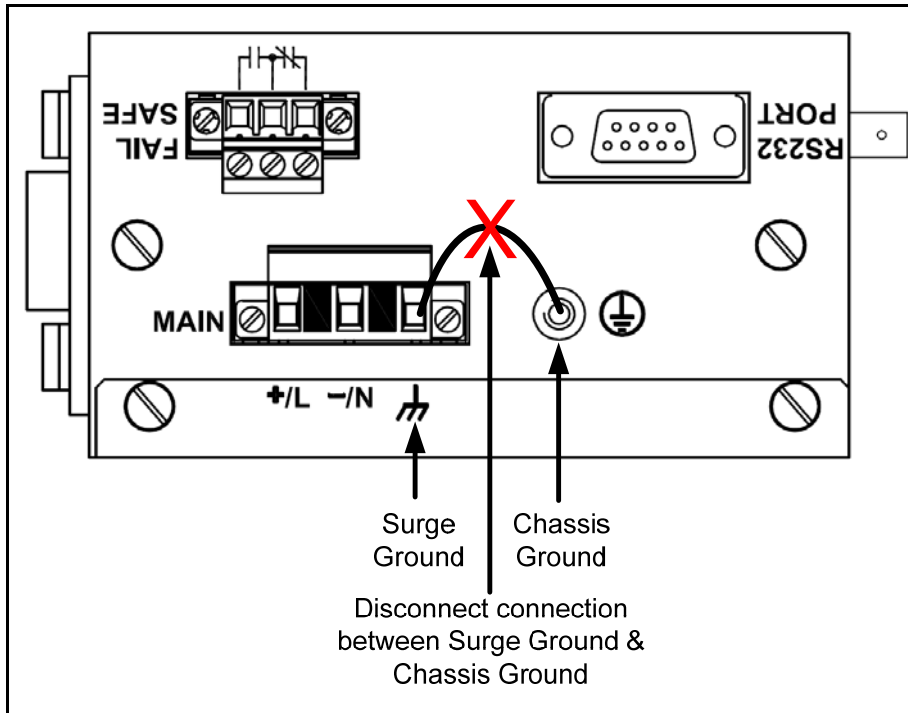


Figure 7 - Dielectric Strength Testing

## 2.3 RS232 Console Port Wiring

The RS232 port is used for configuring the unit. A straight-through serial cable with a DB-9 connector is required. There is no need to crossover the Transmit and Receive signals from the PC side since this has been done internally.

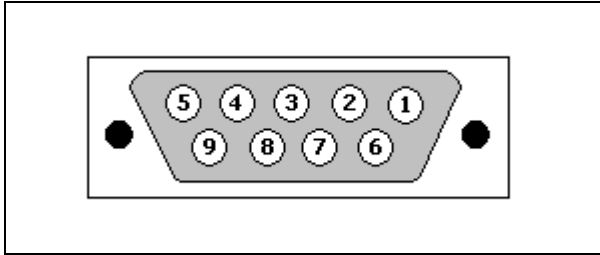


Figure 8 - RS232 Female DCE pin-out

<i>Pin</i>	<i>Signal</i>
1	No Connection
2	Transmit Data
3	Receive Data
4	No Connection
5	Ground
6	No Connection
7	No Connection
8	No Connection
9	No Connection

Table 2 - RS232 Female DCE pin-out

**NOTE:** This port is not intended to be a permanent connection and the cable shall be less than 2m (6.5 ft) in length.

## **3 Ethernet Ports**

### **3.1 *RJ11 Ethernet over VDSL Port***

#### **3.1.1 Overview**

The Ethernet over VDSL (EoVDSL) port operates in pairs with one unit configured as the Master and the other as the Slave. In VDSL literature the terms Central Office (CO) or Line Termination (LT) are used interchangeably for the Master and the terms Customer Premise Equipment (CPE) or Network Termination (NT) are used interchangeably for the Slave. The Master unit dictates the line configuration settings to the Slave so all EoVDSL configuration is done on the Master. Data flowing from the Master to the Slave is designated “downstream” while data flowing from the Slave to the Master is designated “upstream”.

RuggedCom offers two flavours of VDSL: Universal EoVDSL and Long-Reach EoVDSL. Universal EoVDSL ports are Master/Slave selectable and offer symmetric data rates up to 35 Mbps with distances up to 2.5 km. Long-Reach EoVDSL ports are fixed as either Master or Slave but offer asymmetric data rates up to 40 Mbps with distances up to 5 km. The Universal and Long-Reach EoVDSL ports are physically indistinguishable from each other; however, you can determine which port you have either from the order code or through the software.

#### **3.1.2 Wiring**

VDSL typically operates over 2-wire Category 3 (CAT-3) unshielded twisted-pair (UTP) wiring; however, other categorized or uncategorized twisted-pair wiring will work although the performance will vary depending on the distance and cable characteristics. It is important that the wiring used does not have any open leads (also known as bridged taps or drop-lines) along its length because this will impact performance by degrading the signal.

### 3.1.3 RJ11 Port

EoVDSL data ports allow connection using RJ11 male connectors. The figure below shows the RJ11 port pin-out and LEDs. On units with Universal EoVDSL ports the Master LED can be toggled on or off depending on whether the port is set as a Master or Slave. On units with Long-Reach EoVDSL ports the Master unit will have the LED permanently on while the Slave unit will have the LED permanently off.

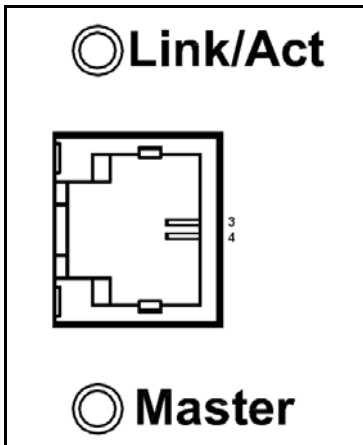


Figure 9 - RJ11 port pin-out and LEDs

<i>Pin</i>	<i>Signal</i>
3	Ring
4	Tip

Table 3 - RJ11 port pin-out

<i>Status LED</i>	<i>Colour</i>	<i>Activity</i>	<i>Comments</i>
Mode	Green	On	Master Mode
		Off	Slave Mode
Link / Act	Green	Solid	Link Established
		Blinking	Tx Activity

Table 4 - RJ11 port LED description

### 3.1.4 Configuration & Setup

If the units have Universal EoVDSL ports, use the software to configure one unit as a Master and the other as a Slave. If the units have a Long-Reach EoVDSL port, no Master/Slave software configuration is necessary since the ports will already be fixed as Master or Slave. Once configured as Master and Slave and connected together, the units will then attempt to achieve the maximum speed based on the line length and conditions. The unit's link LED may flash on and off several times before settling on a final link speed and declaring the port up. For detailed configuration options please consult the Rugged Operating System (ROS) Software User Guide.

### 3.1.5 Performance

The EoVDSL ports can be configured in two modes – Auto Mode and Manual Mode. In Auto Mode, which is the default mode, the unit will step through the different speeds and automatically select the best bit-rate based on current line conditions. In Manual Mode the user can select one of the speed settings and the unit will only attempt to attain the set speed. If the line conditions degrade (reducing the SNR) but the unit is able to maintain the link, an alarm will be triggered to notify the user of the reduced SNR. If the line conditions degrade such that the unit is unable to maintain the current link, the unit will restart the scan process if in Auto Mode or re-attempt to attain the set speed if in Manual Mode.

On 24 American Wire Gauge (AWG) Polyethylene Insulated Cable (PIC) twisted-pair the following performance is typical with Universal EoVDSL ports:

<i>Distance [km]</i>	<i>Distance [feet]</i>	<i>Downstream / Upstream [Mbps]</i>	<i>Time to Achieve Port Up in Auto Mode [Seconds]</i>
0.50	1600	35	15
0.60	2000	30	30
0.70	2300	25	45
0.90	3000	20	60
1.00	3300	15	75
1.30	4300	10	90
1.70	5600	5	105
2.00	6600	2.5	120
2.50	8200	1.2	150

Table 5 - Typical Performance on 24 AWG PIC twisted-pair with Universal EoVDSL ports

The following performance is typical with Long-Reach EoVDSL ports:

<i>Distance [km]</i>	<i>Distance [feet]</i>	<i>Downstream (Master to Slave) [Mbps]</i>	<i>Upstream (Slave to Master) [Mbps]</i>	<i>Time to Achieve Port Up in Auto Mode [Seconds]</i>
0.50	1600	40	20	15
1.00	3300	25	5	30
1.50	4600	20	0.54	45
2.00	6600	15	0.54	60
2.50	8200	10	0.54	75
3.20	10500	5	0.54	90
4.00	13100	2.1	0.54	105
4.60	15100	1.2	0.54	120
5.00	16400	0.48	0.18	150

Table 6 - Typical Performance on 24 AWG PIC twisted-pair with Long-Reach EoVDSL ports

**NOTES:**

1. The EoVDSL ports are designed to be used on private communications lines for point-to-point connections and are not to be connected to the Public Switched Telephone Network (PSTN).
2. To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cord.
3. In Manual Mode, assuming the distance can support the speed setting; the time to port up is typically 15-30 seconds.



### 3.2 RJ45 Ethernet Port

Units with 10/100Base-TX ports allow connection to standard Category 5 (CAT-5) unshielded twisted-pair (UTP) cable with RJ45 male connectors. The RJ45 receptacles are directly connected to the chassis ground on the unit and can accept CAT-5 shielded twisted-pair (STP) cables. If shielded cables are used, care must be taken to ensure the shielded cables do not form a ground loop via the shield wire and the RJ45 receptacles at either end. The figure below shows the shows the RJ45 port pin-out and LEDs.

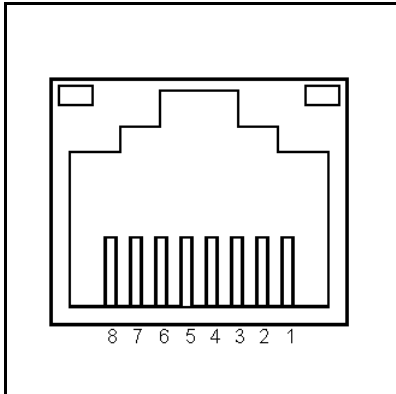


Figure 10 - RJ45 port pin-out and LEDs

<i>Pin</i>	<i>Signal</i>
1	+Rx
2	-Rx
3	+Tx
4	No Connection
5	No Connection
6	-Tx
7	No Connection
8	No Connection
Case	Shield (Chassis Ground)

Table 7 - RJ45 port pin-out

<i>Status LED</i>	<i>Colour</i>	<i>Activity</i>	<i>Comments</i>
Speed LED	Yellow	Off	10 Mbps
		On	100 Mbps
Link LED	Yellow	Solid	Link Established
		Blinking	Tx/Rx Activity

Table 8 - RJ45 port LED description

### 3.3 Fiber Optic Ethernet Port

Depending on the order code of the product, the unit can be equipped with several different fiber optic ports. The Transmit (Tx) and Receive (Rx) connections of each port must be properly connected and matched for proper link and operation. The drawings in the following figures show each fiber optical connector style with a side and top view to allow the user to identify the proper cable connection orientation.

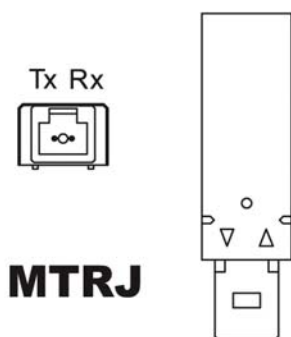


Figure 11 - 100FX MTRJ connector

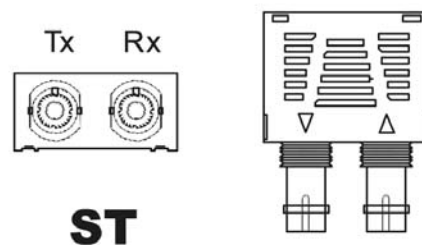


Figure 12 - 100FX ST connector

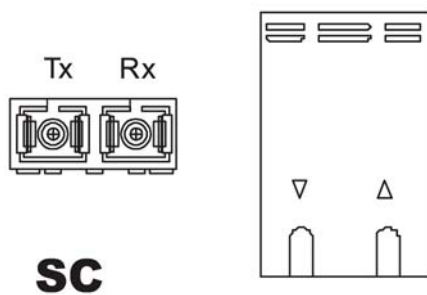


Figure 13 - 100FX SC connector

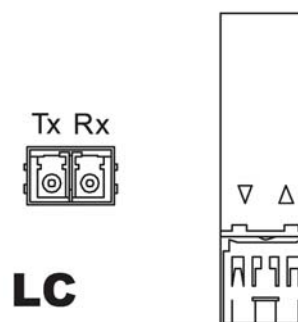


Figure 14 - 100FX LC connector

### **3.4 Wireless Ethernet Port**

Refer to the "RuggedCom Wireless Guide" for an introduction to 802.11 Ethernet-based wireless technologies as well as answers to frequently asked questions.

Refer to the "Rugged Operating System (ROS) User Guide" for instructions on wireless port configuration.

Both of the above documents can be downloaded from the following webpage:

<http://www.ruggedcom.com/products/ruggedwireless/rs900w>

## 4 Serial Ports

Serial ports can be either DB9 Serial ports, RJ45 serial ports or Fiber Serial ports

### 4.1 DB9 Serial Port

The DB9 port is selectable via software to be RS232, RS485 or RS422.

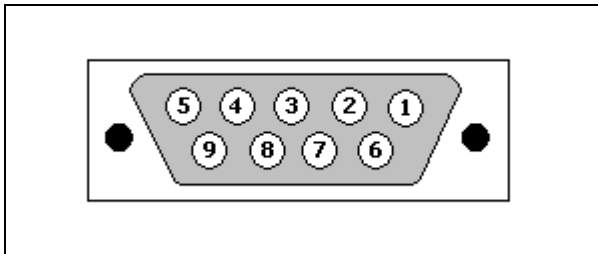


Figure 15: DB9 Female DCE Port pin-out

Pin	RS232 Mode	RS485 Mode	RS422 Mode
1	DCD	-	-
2	TX	TX/RX+	TX+
3	RX	-	RX+
4	DTR	-	-
5	Common (Isolated Ground)		
6	DSR	-	RX-
7	CTS	TX/RX -	TX-
8	RTS	-	-
9	RI (No Connection)	-	-
Shield	Chassis Ground		

Table 9: DB9 Female DCE Port pin-out

#### NOTES:

1. No internal termination is provided.
2. Pins 1, 4, and 6 are connected internally. Pins 7 and 8 are connected internally. The pins are permanently asserted to 5V so that DTE devices that require DCD, DTR, or CTS signals will operate. However, hardware flow control via RTS is not recognized.
3. The Common terminals are optically isolated; however, there is transient voltage protection circuitry between the Common terminals and chassis ground.

## 4.2 RJ45 Serial Port

The RJ45 Serial port is selectable via software to be RS232, RS485 or RS422.

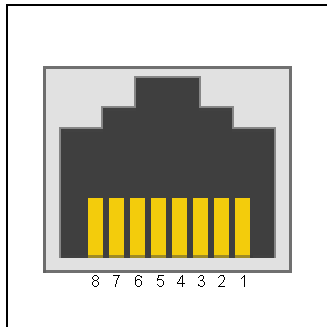


Figure 16: RJ45 Port pin-out

Pin	RS232 Mode	RS485 Mode	RS422 Mode
1	DSR	-	RX-
2	DCD	-	-
3	DTR	-	-
4	Common (Isolated Ground)		
5	RX	-	RX+
6	TX	TX/RX +	TX +
7	CTS	-	-
8	RTS	TX/RX -	TX -
Shield	Chassis Ground		

Table 10: RJ45 Port pin-out

### NOTES:

1. No internal termination is provided.
2. Pins 1, 2, and 3 are connected internally. Pins 7 and 8 are connected internally. The pins are permanently asserted to 5V so that DTE devices that require DCD, DTR, or CTS signals will operate. However, hardware flow control via RTS is not recognized.
3. The Common terminals are optically isolated; however, there is transient voltage protection circuitry between the Common terminals and chassis ground.

### 4.3 Fiber Serial Port

The Fiber Serial Interface (ST connector only) which allows RS485, RS422, or RS232 devices to communicate over secure, noise immune, optically isolated, fiber optic cabling at extended distances as well as protocol independent conversion to multimode fiber optics.

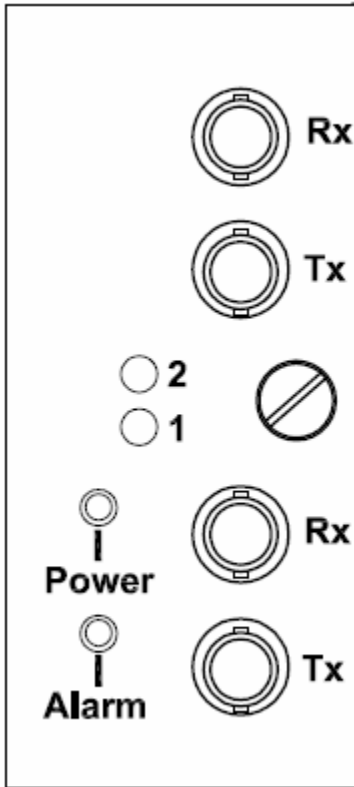


Figure 17: Fiber Serial Interface (ST Connector)

## 4.4 RS485 Wiring

Each RS485 port can communicate to multiple RS485 devices by daisy chaining devices over a single twisted pair with transmit and receive signals on the same two wires (half duplex). The following guidelines should be followed to ensure reliable continuous communication:

1. To minimize the effects of ambient electrical noise, shielded cabling is recommended.
2. The correct polarity must be observed throughout a single daisy chain.
3. The number of devices wired should not exceed 32, and total distance should be less than 4000 feet (at 100 kbps).
4. The Common terminals should be connected to the common wire inside the shield.
5. The shield should be connected to earth ground at a single point to avoid loop currents
6. The twisted pair should be terminated at each end of the chain.

The figure below shows the recommended RS485 wiring.

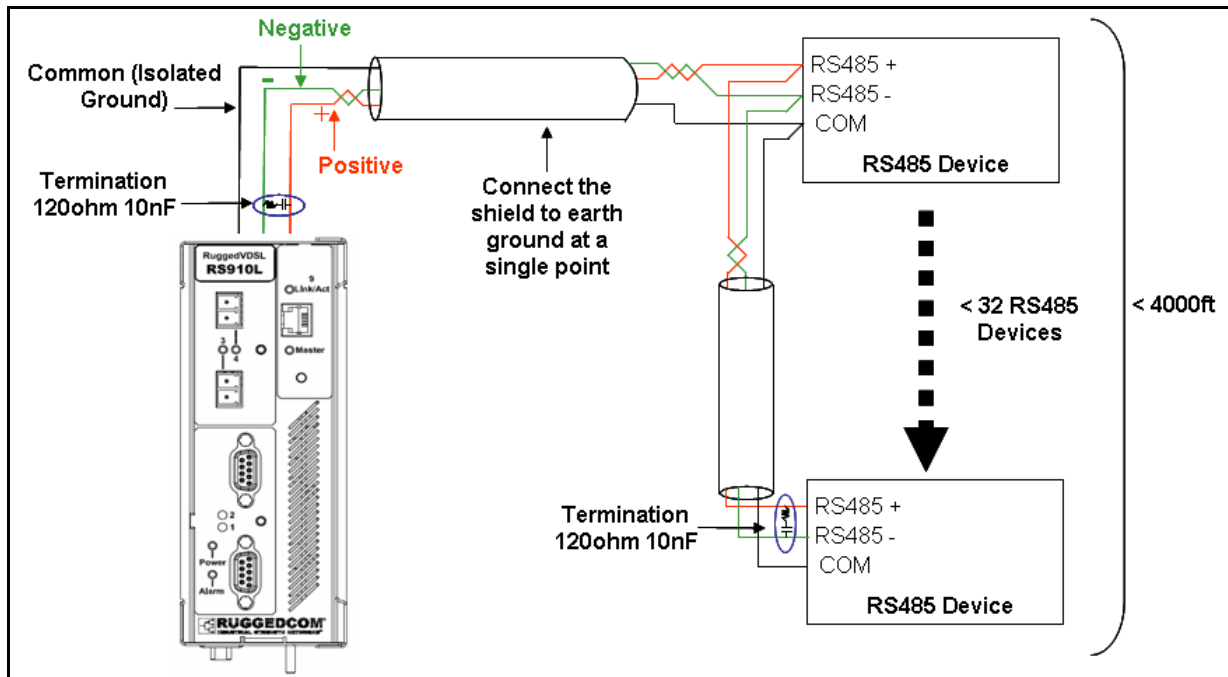


Figure 18: Conceptual recommended RS485 wiring diagram

## 5 Transient Protection

RuggedCom does not recommend the use of copper cabling of any length for critical real-time substation automation applications. However, transient suppression circuitry is present on all copper ports to protect against damage from electrical transients and to ensure IEC 61850-3 and IEEE 1613 Class 1 conformance. This means that during the transient event communications errors or interruptions may occur but recovery is automatic.

RuggedCom also does not recommended to use these ports to interface to field devices across distances which could produce high levels of ground potential rise, (i.e. greater than 2500V) during line to ground fault conditions.



## 6 Technical Specifications

### 6.1 Operating Environment

<i>Parameter</i>	<i>Range</i>	<i>Comments</i>
Ambient Operating Temperature	-40 to 85°C	Ambient Temperature as measured from a 30 cm radius surrounding the center of the enclosure.
Ambient Storage Temperature	-40 to 85°C	
Ambient Relative Humidity	5% to 95%	Non-condensing

Table 11 - Operating Environment

### 6.2 Power Supply Specifications

<i>Power Supply Type</i>	<i>Minimum Input</i>	<i>Maximum Input</i>	<i>Fuse Rating</i>	<i>Isolation</i>	<i>Maximum Power Consumption</i>
12 – 24 VDC	10 VDC	36 VDC	3.15 (T)	1.5 kV DC	10W
24 VDC	18 VDC	36 VDC	3.15 (T)	1.5 kV DC	
48 VDC	36 VDC	72 VDC	3.15 (T)	1.5 kV DC	
HI (125/250 VDC) <sup>1</sup> HI (110/230 VAC) <sup>1</sup>	88 VDC 85 VAC	300 VDC 265 VAC	3.15 (T)	4 kV AC 5.5 kV DC	

Table 12 - Power Supply Specifications

**NOTES:**

1. This is the same power supply for both AC and DC.
2. (F) Denotes fast-acting fuse, (T) denotes time-delay fuse.
3. For continued protection against risk of fire, replace only with same type and rating of fuse.

### 6.3 Failsafe Relay Specifications

<i>Parameter</i>	<i>Value</i>
Max Switching Voltage	30VAC, 80VDC
Rated Switching Current	0.3A @ 30VAC 1A @ 30VDC, 0.3A @ 80VDC

Table 13 - Failsafe Relay Specification

**NOTES:**

1. Resistive Load.
2. For Class-2 circuits only.

<i>Isolation</i>	<i>Comments</i>
1500 V <sub>rms</sub>	Dielectric test voltage (1 minute) between coil & contacts

Table 14 - Failsafe Relay Isolation

## **6.4 Ethernet Ports Specifications**

### **6.4.1 RJ11 Ethernet over VDSL Port Specifications**

<i>Data Port</i>	<i>Media</i>	<i>Distance</i>	<i>Connector Type</i>
EoVDSL	CAT-3 UTP or STP	2500m	RJ11

Table 15 – RJ11 Ethernet over VDSL Port Specifications

### **6.4.2 RJ45 Ethernet Port Specifications**

<i>Data Port</i>	<i>Media</i>	<i>Distance</i>	<i>Connector Type</i>
10/100 Mbps	CAT-5 UTP or STP	100m	RJ45

Table 16 – RJ45 Ethernet Port Specifications

### 6.4.3 Fiber Optic Ethernet Port Specifications

Order Code	Speed Standard	Mode / Connector	Tx (nm)	Cable Type (um)	Tx min (dBm)	Tx max (dBm)	Rx Sensitivity (dBm)	Rx Saturation (dBm)	Typical Distance (km)	Power Budget (dB)
MJ	100FX	MM/MTRJ	1300	50/125 62.5/125	-22.5 -19	-14 -14	-33.5 -33.5	-14 -14	2 2	11 14.5
MC	100FX	MM/SC	1300	50/125 62.5/125	-22.5 -19	-14 -14	-33.9 -33.9	-14 -14	2 2	11.4 14.9
MT	100FX	MM/ST	1300	50/125 62.5/125	-22.5 -19	-14 -14	-33.9 -33.9	-14 -14	2 2	11.4 14.9
ML	100FX	MM/LC	1310	62.5/125	-19	-14	-32	-14	2	13
T2	100FX	SM/ST	1310	9/125	-15	-7	-34	-3	20	19
L2	100FX	SM/LC	1300	9/125	-15	-8	-38	-3	20	23
C2	100FX	SM/SC	1300	9/125	-15	-8	-31	-7	20	16
L5	100FX	SM/LC	1310	9/125	-5	0	-35	-3	50	30
C5	100FX	SM/SC	1310	9/125	-5	0	-34	-3	50	29
L9	100FX	SM/LC	1310	9/125	0	5	-37	0	90	37
C9	100FX	SM/SC	1310	9/125	5	0	-37	0	90	42

Table 17 - Fiber Optic Port Specifications

## NOTES:

1. All values listed are average values
2. To convert from average to peak add 3 dBm. To convert from peak to average, subtract 3 dBm.
3. Maximum segment length is greatly dependent on factors such as fiber quality, and number of patches and splices. Please consult RuggedCom sales associates when determining maximum segment distances.

## 6.4.4 Communication Standards

<i>Protocol</i>	<i>Standards</i>
Ethernet	IEEE 802.3
VDSL	ETSI TS 101 270-2 V1.1.1, ITU-T G.993.1, ANSI T1E1.4

Table 18 - Communication Standard Compliance

## 6.5 Wireless Ethernet Port Specification

### 6.5.1 Wireless Standards Supported

<i>Standard</i>	<i>Parameter</i>	<i>Mode</i>	<i>Notes</i>
IEEE 802.11g	54 Mbps (WLAN)	Full Access Point	2.4 GHz ISM
IEEE 802.11b	11 Mbps (WLAN)	Client support	Backwards compatibility
IEEE 802.11i	Strong Encryption	WPA2-AES (CCMP)	Robust Secure Network (RSN)
	Enhanced Encryption	WPA-TKIP (RC4)	Temporal keys
	Basic Encryption	WEP (RC4)	Up to 4 static keys
IEEE 802.1x	Wireless Authentication	'Personal' or 'Enterprise'	PSK or RADIUS

Table 19 - Wireless Standards Supported

### 6.5.2 Radio Characteristics

<i>Standard</i>	<i>Parameter</i>
Modulation	Direct Sequence Spread Spectrum 802.11b / OFDM 802.11g
Frequency Range	2.4 Ghz – 2.4965 Ghz
Data Rate	6-54 Mbps: OFDM 11 Mbps: CCK 5.5 Mbps: CCK 2 Mbps: DQPSK 1 Mbps: DBPSK
Channels	11 – US (FCC) 11 - CAN (IC) 14 – Japan (MKK) 13 – Other countries (ETS)
Output Power	100 mW (20dBm) 802.11b 11Mbps Data Rate 100 mW (20dBm) 802.11g 6-24Mbps Data Rate 79 mW (19dBm) 802.11g 36Mbps Data Rate 63 mW (18dBm) 802.11g 48Mbps Data Rate 40 mW (16dBm) 802.11g 54Mbps Data Rate
Receiver Sensitivity	At Radio 802.11b 11Mb@-88dBm / With Antenna: 11Mb@-91dBm At Radio 802.11g 54Mb@-74dBm / With Antenna: 54Mb@-77dBm

Table 20 - Radio Characteristics

### 6.5.3 Channel Allocations for IEEE 802.11b/g

The channel identifiers, channel center frequencies, and regulatory domains of each IEEE 802.11b/g 22-MHz-wide channel are shown in the table below.

Channel Identifier	Frequency (MHz)	Regulatory Domains			
		America (-A)	EMEA (-E)	Japan (-J)	Rest of World (-W)
1	2412	X	X	X	X
2	2417	X	X	X	X
3	2422	X	X	X	X
4	2427	X	X	X	X
5	2432	X	X	X	X
6	2437	X	X	X	X
7	2442	X	X	X	X
8	2447	X	X	X	X
9	2452	X	X	X	X
10	2457	X	X	X	X
11	2462	X	X	X	X
12	2467	-	X	X	X
13	2472	-	X	X	X
14	2484	-	-	X	-

Table 21 - Channel allocations for IEEE 802.11b/g

**NOTES:**

- Mexico is included in the Rest of World regulatory domain; however, channels 1 through 8 are for indoor use only while channels 9 through 11 can be used indoors and outdoors. Users are responsible for ensuring that the channel set configuration complies with the regulatory standards of Mexico.
- In Japan, channel 14 is not supported for 802.11g mode.

## 6.6 Serial Ports Specifications

### 6.6.1 DB9 & RJ45 Serial Port Specifications

<i>Parameter</i>	<i>Specifications</i>	<i>Notes</i>
Baud Rate	300 bps – 230 kbps	
Connector	DB9 or RJ45	
Isolation	2.5 kV	RMS 1-minute

Table 22: Copper Port Specification

### 6.6.2 Fiber Serial Port Specifications

<i>Parameter</i>	<i>Specifications</i>
Mode	Multimode
Connector	ST
Typical Dist. (km)	5
Optical Wavelength (nm)	820
Cable Size Core/Cladding (um)	50/125 62.5/125

Table 23: Fiber Optic Port Specification

## 6.7 Mechanical Specifications

Parameter	Value
Dimensions	16.8 x 11.7 x 6.6 cm / 6.6 x 4.6 x 2.6 inches
Weight	1.2 kg / 2.7 lbs
Enclosure	20 AWG Galvanized Steel

Table 24 - Mechanical Specifications

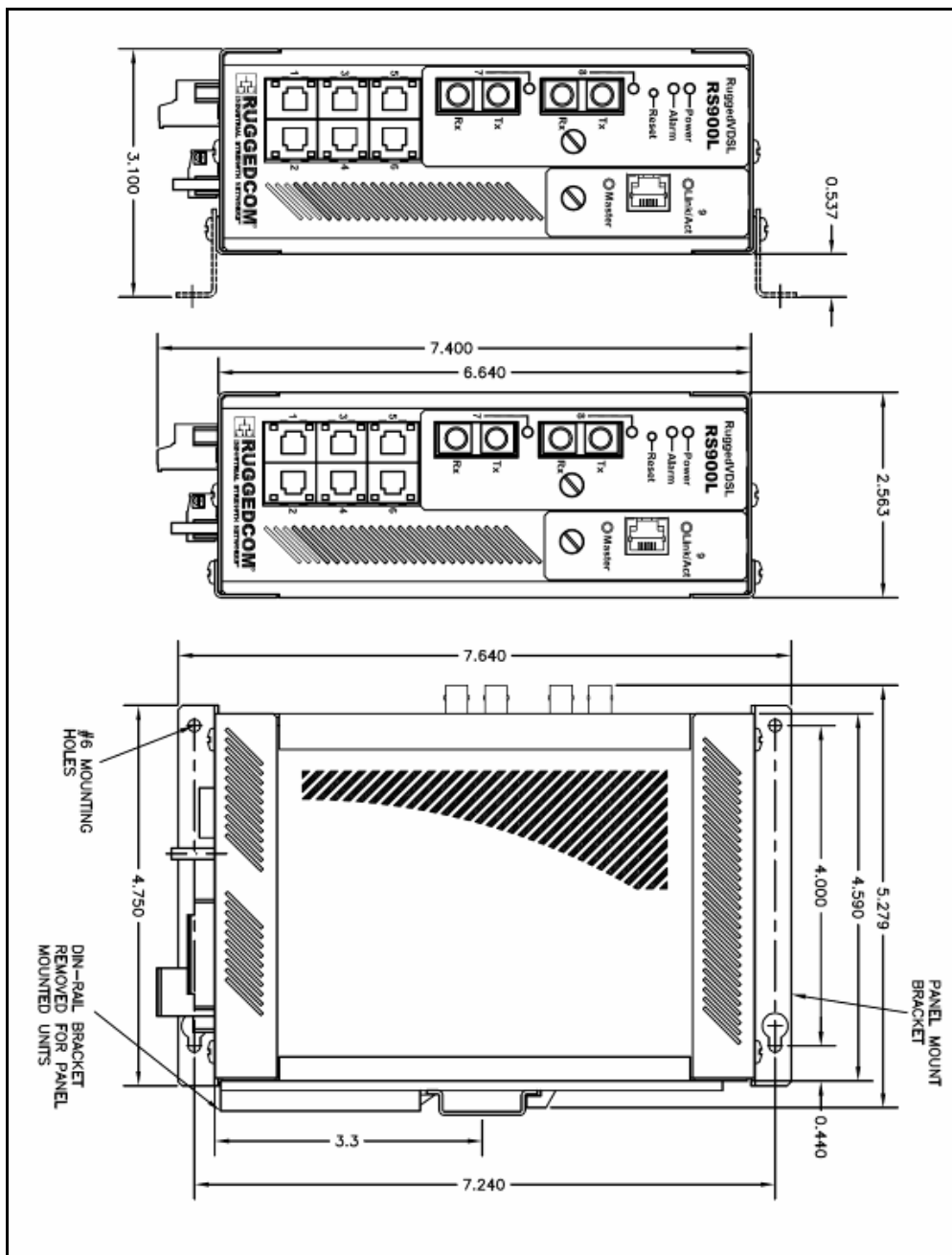


Figure 19 - Mechanical Specifications



## 7 Type Tests

### 7.1 IEC 61850-3 Type Tests

Test	Description		Test Levels	Severity Levels
IEC 61000-4-2	ESD	Enclosure Contact	+/- 8kV	4
		Enclosure Air	+/- 15kV	4
IEC 61000-4-3	Radiated RFI	Enclosure ports	20 V/m	x
IEC 61000-4-4	Burst (Fast Transient)	Signal ports	+/- 4kV @ 2.5kHz	x
		D.C. Power ports	+/- 4kV	4
		A.C. Power ports	+/- 4kV	4
		Earth ground ports	+/- 4kV	4
IEC 61000-4-5	Surge	Signal ports	+/- 4kV line-to-earth, +/- 2kV line-to-line	4
		D.C. Power ports	+/- 2kV line-to-earth, +/- 1kV line-to-line	3
		A.C. Power ports	+/- 4kV line-to-earth, +/- 2kV line-to-line	4
IEC 61000-4-6	Induced (Conducted) RFI	Signal ports	10V	3
		D.C Power ports	10V	3
		A.C. Power ports	10V	3
		Earth ground ports	10V	3
IEC 61000-4-8	Magnetic Field	Enclosure ports	40 A/m continuous, 1000 A/m for 1 s	N/A
IEC 61000-4-29	Voltage Dips & Interrupts	D.C. Power ports	30% for 0.1s, 60% for 0.1s, 100% for 0.05s	N/A
IEC 61000-4-11		A.C. Power ports	30% for 1 period, 60% for 50 periods 100% for 5 periods, 100% for 50 periods <sup>2</sup>	N/A
IEC 61000-4-12	Damped Oscillatory	Signal ports	2.5kV common, 1kV differential mode @ 1MHz	3
		D.C. Power ports	2.5kV common, 1kV differential mode @ 1MHz	3
		A.C. Power ports	2.5kV common, 1kV differential mode @ 1MHz	3
IEC 61000-4-16	Mains Frequency Voltage	Signal ports	30V Continuous, 300V for 1s	4
		D.C. Power ports	30V Continuous, 300V for 1s	4
IEC 61000-4-17	Ripple on D.C. Power Supply	D.C. Power ports	10%	3
IEC 60255-5	Dielectric Strength	Signal ports	2kV AC (Fail-Safe Relay output)	N/A
		D.C. Power ports	2kV AC	N/A
		A.C. Power ports	2kV AC	N/A
IEC 60255-5	H.V. Impulse	Signal ports	5kV (Fail-Safe Relay output)	N/A
		D.C. Power ports	5kV	N/A
		A.C. Power ports	5kV	N/A

Table 25 - IEC 61850-3 Type Tests

## 7.2 IEEE 1613 Type Tests

IEEE Test	IEEE 1613 Clause	Description		Test Levels
C37.90.3	9	ESD	Enclosure Contact	+/- 8kV
			Enclosure Air	+/- 15kV
C37.90.2	8	Radiated RFI	Enclosure ports	35 V/m
C37.90.1	7	Fast Transient	Signal ports	+/- 4kV @ 2.5kHz
			D.C. Power ports	+/- 4kV
			A.C. Power ports	+/- 4kV
			Earth ground ports	+/- 4kV
C37.90.1	7	Oscillatory	Signal ports	2.5kV common mode @ 1MHz
			D.C. Power ports	2.5kV common & differential mode @ 1MHz
			A.C. Power ports	2.5kV common & differential mode @ 1MHz
C37.90	6	H.V. Impulse	Signal ports	5 kV (Failsafe Relay)
			D.C. Power ports	5 kV
			A.C. Power ports	5 kV
C37.90	6	Dielectric Strength	Signal ports	2kV AC(Failsafe Relay)
			D.C. Power ports	2kV AC
			A.C. Power ports	2kV AC

Table 26 - IEEE 1613 Type Tests

## NOTE:

- If the unit contains copper ports the IEEE 1613 conformance is Class 1 (During disturbance errors may occur but recovery is automatic).
- If the unit contains all fiber ports the IEEE 1613 conformance is Class 2 (During disturbance no errors will occur).

## 7.3 IEC Environmental Type Tests

Test	Description		Test Levels	Severity Levels
IEC 60068-2-1	Cold Temperature	Test Ad	-40 deg. C, 16 Hours	N/A
IEC 60068-2-2	Dry Heat	Test Bd	+85 deg. C, 16 Hours	N/A
IEC 60068-2-30	Humidity (Damp Heat, Cyclic)	Test Db	95% (non-condensing), 55°C, 6 cycles	N/A
IEC 60255-21-1	Vibration	Tests Fc	2g @ (10-150) Hz	Class 2
IEC 60255-21-2	Shock	Tests Ea	30g @ 11 ms	Class 2

Table 27 - Environmental Type Tests